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## Amendments to the Specification:

Replace paragraph [13] on pages 3-4 with the following new paragraph [13]:

[13] The PEM used in solid polymer fuel cells acts both as the electrolyte as well as a barrier that prevents the mixing of the reactant gases, a potentially disastrous situation. Examples of suitable membrane materials are the polymeric perfluorocarbon ionomers generally containing a basic unit of fluorinated carbon chain and one or more sulphonic acid groups. There may be variations in the molecular configurations and/or molecular weights of this membrane. One such membrane commonly used as a fuel cell PEM is sold by E. I. DuPont de Nemours under the trademark ~~"Nafion."~~ "NAFION" (tetrafluoroethylene-perfluoro-3,6-dioxa-4-methyl-7-octenesulfonic acid copolymer). Typically, best fuel cell performance is obtained using these membranes if the fuel cells are operated under fully hydrated, *i.e.* essentially water-saturated, conditions. Thus, the PEM must be continuously humidified during fuel cell operation.

Replace paragraph [30] on page 10 with the following new paragraph [30]:

[30] Figures 3A and 3B are current voltage and power curves measured for a nonmagnetic cell formed with 0.365 mg/cm$^2$ of Pt on the anode and 0.354 mg/cm$^2$ on the cathode, recorded at 70°C and 25°C, respectively, using $O_2$ as the oxidant source. Figures 4A and 4B are current voltage and power curves measured for a magnetically modified cell formed with 0.450 mg/cm$^2$ of Pt and 0.523 mg/cm$^2$ of magnetic microparticles ($Fe_3O_4$ particles coated with 2% poly(4-styrene sulfonic acid)-polystyrene copolymer) on the anode and 0.430 mg/cm$^2$ of Pt and 0.501 mg/cm$^2$ of magnetic

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microparticles on the cathode, recorded at 70°C and 25°C, respectively, using $O_2$ as the oxidant source. Figures 5A and 5B are current voltage and power curves measured for the same magnetically modified cell, recorded at 70°C and 25°C, respectively, using air as the oxidant source.

Replace paragraph [49] on page 15 with the following new paragraph [49]:

[49] The amount of catalyst component(s) present in the catalytic material will vary depending upon the particular catalyst component(s) selected, the gaseous reactants involved and the like. Suitable amounts of catalyst component for a particular membrane electrode assembly may therefore be determined empirically by one skilled in the art. By way of illustration and not of limitation, if, for example, the catalyst component on the cathode and/or anode is platinum, then it may preferably be present in any amount from 0.1 mg/cm$^2$ up to 1 mg/cm$^2$ or even several mg/cm$^2$, such as 0.1 mg/cm$^2$ to 0.8 mg/cm$^2$, and more preferably in an amount of about 0.1 mg/cm$^2$ to about 0.5 mg/cm$^2$, such as about 0.3 mg/cm$^2$ to about 0.4 mg/cm$^2$.

Replace paragraph [50] on page 15 with the following new paragraph [50]:

[50] In addition to the catalyst component or components, the catalytic material may also further comprise at least one ion conducting material. Suitable ion conducting materials are known and available to those skilled in the art. Illustrative examples of such ion conducting materials include, but are not limited to, polymers generally useful in polymer electrolyte membranes. Particularly preferred ion conducting materials include perfluoroinated sulfonic acid polymers, such

as the material known under the trademark ~~Nafion~~ NAFION (tetrafluoroethylene-perfluoro-3,6-dioxa-4-methyl-7-octenesulfonic acid copolymer) and available from E.I. DuPont de Nemours or Ion Power, Inc. A most preferred ion conducting material for use in various embodiments of the present invention is ~~Nafion~~ NAFION 1100 (tetrafluoroethylene-perfluoro-3,6-dioxa-4-methyl-7-octenesulfonic acid copolymer 1100). According to certain very preferred embodiments, the ion conducting material in the catalytic material on the cathode and the anode is the same as the ion conducting material of the separator.

Replace paragraph [53] on page 16 with the following new paragraph [53]:

[53] Suitable modifying materials are known and available to those skilled in the art. Illustrative examples of suitable modifying materials include, but are not limited to, polyalkylenes and derivatives thereof, such as partially or fully fluorinated polyalkylenes (e.g. ~~Teflon~~ TEFLON, polytetrafluoroethylene). A particularly preferred polyalkylene for use in certain embodiments of the present invention, such as membrane electrode assemblies that employ perfluoroinated sulfonic acid polymers (e.g. ~~Nafion~~ NAFION, tetrafluoroethylene-perfluoro-3,6-dioxa-4-methyl-7-octenesulfonic acid copolymer) as the ion conducting material, is polyethylene.

Replace paragraph [85] on page 25 with the following new paragraph [85]:

[85] By way of illustration, when a ~~Nafion~~ NAFION (tetrafluoroethylene-perfluoro-3,6-dioxa-4-methyl-7-octenesulfonic acid copolymer) polymer electrolyte membrane (such as those

available from Ion Power, Inc.) is employed as the separator, a particularly preferred modifying process involves contacting the membrane with an acidic solution at elevated temperature for a sufficient period of time. For example, a 50 micron thick membrane composed of ~~Nafion~~ NAFION 1100 (tetrafluoroethylene-perfluoro-3,6-dioxa-4-methyl-7-octenesulfonic acid copolymer 1100) is preferably contacted with a 50% aqueous solution of sulfuric acid at 90°C for two hours prior to incorporation into a membrane electrode assembly of the present invention.

Replace paragraphs [94]-[96] on pages 28-29 with the following new paragraphs [94]-[96]:

[94] Catalytic ink formulation and production – Due to the coating of the catalytic ink on the inside of the mixing container, an excess of 10 fold for one electrode was prepared in order to ensure a proper mix and that there was an adequate supply of ink to coat both the anode and the cathode electrodes gas diffusion layer (GDL). The formulation of enough ink to coat 50 $cm^2$ of electrodes and with a Pt and magnetic loading of 0.4 $mg/cm^2$ follows: (1) 0.100 g Alfa Aesar 20% Pt on carbon support; (2) 1.200 g of Liquion-1100 (5 wt% ~~Nafion~~ NAFION 1100 ((tetrafluoroethylene-perfluoro-3,6-dioxa-4-methyl-7-octenesulfonic acid copolymer 1100) EW solution); (3) 1.100 g of de-ionized water; and (4) 0.040 of polymer coated magnetic particles.

[95] To aid in the mixing of the catalytic ink, two 10 mm and one 5 mm aluminum oxide spheres were added to the formulation. The container used to mix the ink was a 30 ml ~~Nalgene~~ NALGENE (Nalge Nunc International Corporation, Rochester, NY U.S.A) high density polyethylene bottle with a screw top lid that was sealed with ~~Parafilm~~ PARAFILM (polyolefin film) prior to

mixing. The ink was mixed using a 3/8" variable speed drill with input power controlled by a variable alternating current resistor. The mixing container was attached substantially parallel to the axis of the chuck of the drill (preferably at a slightly offset angle) using a buret clamp. One end of the clamp was inserted into to chuck of the drill and the other end was clamped to the top of the bottle where the length of the bottle was substantially (but not exactly) parallel to the shaft of the buret clamp. The mix was rotated at 80% full power, 2000 rpm, for 30 sec. behind a ~~Plexiglas~~ PLEXIGLAS (polymethyl methacrylate) safety shield.

[96] Catalytic ink painting – Two double-sided ELAT carbon cloth (~~E-Tek~~ available from E-TEK Division, Somerset, NJ.) electrodes were cut so that the resulting electrode was substantially square with an area of about 5 $cm^2$. 1/10 of the ink formulation prepared above was then applied to the electrode in two steps. First, a thin layer of ink was painted onto the electrode surface using a short bristle brush. Second, the remainder of the ink was pipetted onto the electrode surface having the thin layer of painted ink, and the electrode tilted repeatedly until the ink substantially uniformly covered the electrode surface. The electrodes were allowed to dry in a fume hood until visibly dry, followed by final drying under vacuum (40 mTorr) for about two hours at ambient temperature.

Replace paragraph [97] on page 29 with the following new paragraphs [97]:

[97] The polymer electrolyte membrane used was a ~~Nafion~~ NAFION 1100 (tetrafluoroethylene-perfluoro-3,6-dioxa-4-methyl-7-octenesulfonic acid copolymer 1100) EW membrane about 50 microns thick before treatment and manufactured by Ion Power, Inc. The

membrane was cut into 3" x 3" squares and then subjected to the following process: (1) 30 min. in 500 ml of 5% $H_2O_2$ at 100 °C; (2) 60 min in 500 ml of 0.1M $HNO_3$ at 90°C; (3) dipped into a boiling de-ionized water rinse; (4) 120 min in 500 ml of 50% $H_2SO_4/H_2O$ at 90°C; and (5) 30 min boiling de-ionized water rinse.

Replace paragraphs [99]-[100] on pages 29-30 with the following new paragraphs [99]-[100]:

[99] The lamination of the MEA was a hot-press of the following stack (top to bottom): (1) ~~Furon~~ FURON (silicone rubber), 5" x 5" x 0.015"; (2) ~~Teflon~~ TEFLON (polytetrafluoroethylene), 45 mm x 45 mm x 0.062"; (3) ~~Kapton~~ KAPTON (polyimide), 5" x 5" x 0.002"; (4) electrode, catalytic material layer face down; (5) ~~Nafion~~ NAFION (tetrafluoroethylene-perfluoro-3,6-dioxa-4-methyl-7-octenesulfonic acid copolymer) membrane; (6) electrode, catalytic material layer face up; (7) ~~Kapton~~ KAPTON (polyimide), 5" x 5" x 0.002"; (8) ~~Teflon~~ TEFLON (polytetrafluoroethylene), 45 mm x 45 mm x 0.062"; and ~~Furon~~ FURON (silicone rubber), 5" x 5" x 0.015".

[100] The above stack was placed between two temperature-controlled platens of a hydraulic press (15 ton Carver with thermostatically controlled platens). The platens were brought together until the pressure started to increase and the temperature of both platens was set to 128°C. With this press, the temperature ramp takes about 20 min. When the platens reached the desired temperature, the pressure was increased to 0.25 metric tons and held there for three minutes. The pressure was then decreased to that equal to the pressure are the start of the temperature ramp, and the temperature is reduced to 25°C. The ~~Furon~~ FURON (silicone rubber), ~~Teflon~~ TEFLON

(polytetrafluoroethylene) and ~~Kapton~~ KAPTON (polyimide) layers were then removed using de-ionized water from a squirt bottle.